after the death of the former, whose soul is transported to Mars, they get into communication with each other.

The posthumous papers consist of the record left by the son, who describes all their experiments, hopes, failures, successes, and, lastly, the extra-planetary wireless messages he received.

Those interested in this class of fiction can spend a pleasant hour or two over these pages.

On the Lakes of South-eastern Wisconsin. By Prof. N. M. Fenneman. *Bulletin* viii. of Wisconsin Geol. and Nat. History Survey. Pp. xv+178. (Madison, Wisconsin: Published by the State, 1902.)

THE preface and the introduction announce the object of this work. It is intended as a guide to the teacher of geology, and shows how the shores of these lakes may form beautiful illustrations of the principles of wave, current, and ice action. The first chapter gives a general account of the origin of such lakes, and the second is devoted to a general and more or less theoretical discussion of the geological agents at work. After this the lakes are taken up one by one, and it is shown how the various features of the shore have arisen. There are many very good and aptly chosen photographs, which bring out clearly the points mentioned in the text, and make the book interesting even to those who cannot see the lakes for themselves.

Most of the book is devoted to the features of the shores, but it is also shown how the hydrographic maps may be used to decipher the origin of the basins, and in the case of Lake Mendota there is an interesting discussion of the results obtained by dredging, which are said to indicate currents below the wave-base. The unpublished work of the director of the Survey, Dr. Birge, on the temperature of these lakes is also said to confirm these conclusions. We shall look forward to the publication of these temperature observations. E. R. W.

Malessere Agrario ed Alimentare in Italia. By Italo Giglioli, Direttore della R. Stazione Agraria di Roma, &c. Pp. lxxxii+797. (Portici, 1903.)

IN this work Prof. Giglioli has attempted a detailed survey of the agricultural state of Italy in comparison with other nations. He considers one by one the various branches of the industry, the production of wheat, maize, rice and other cereals, wine, fruit, olives and silk, eggs, butter, cheese and the many minor branches of rural activity which are possible in the climate of Italy. In each case a comparison is drawn between the conditions of the past and those which prevail to-day both in Italy and the chief competing countries. Both as an ardent patriot and a man of science, Prof. Giglioli is troubled by the increasing poverty of the rural districts as compared with the towns, especially when one travels out of the favoured northern provinces of Lombardy and Tuscany into middle and southern Italy. He indicates how the actual production of the land is declining, so that Italy with all its traditional farming skill and with the vast possibilities of its climate is coming to be more and more dependent upon other nations for food which could be grown within its own borders if only more intensive methods of cultivation were resorted to. Aggravated as the case is in parts of Italy by the poverty of the people and their entire dependence upon agriculture, the problem is one which all the west European States are being called upon to face; how can agriculture, which is a primitive industry, live in a highly civilised State against the competition of the great areas of virgin soil like Argentina or the North-West? To English economists who want an enlightened and temperate review of the situation in a nation not unlike our own we commend Prof. Giglioli's book.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Does the Radio-activity of Radium depend upon its Concentration?

SOME experiments have recently been made to test whether the radio-activity of radium is influenced by the continuous bombardment to which it is subjected by its own radiations. In an article in this Journal on radium (April 30, 1903) Prof. J. J. Thomson suggested that the radio-activity of radium may possibly depend upon its degree of concentration, and that a given quantity of radium, diffused throughout a mass of pitchblende, may be less than when concentrated in a small mass. In order to test this point, measurements of the radio-activity of radium bromide were made when in the solid state and when diffused throughout the mass of a solution more than a thousand times the volume occupied by the radium compound.

Two tubes, closed at one end, were taken, in one of which was placed about a milligram of pure solid radium bromide and in the other a solution of radium chloride. The tubes were connected near the top by a cross tube, and the open ends were then sealed by a blowpipe.

Measurements of the radio-activity of the radium were made by means of an electroscope. The tubes, fixed on a stand, were placed in a definite position near an electroscope and the rate of discharge observed. This was due to the β and γ rays emitted by the radium, since the α rays were completely absorbed in the walls of the tube. By placing a lead screen 6 mm. thick between the tubes and the electroscope the rate of discharge was due to the γ rays alone.

After measurements of the activity had been made, the glass apparatus was tilted so as to allow the radium chloride to flow into the arm containing the radium bromide. This dissolved the radium, and part of the emanation was released and distributed itself throughout the tubes.

No appreciable change of the radio-activity of radium was observed over a month's interval. If the rate of production of the emanation, or the excited activity caused by it, had varied during the interval, a corresponding change would have been observed in the rate of discharge due to the γ rays, for other experiments have shown that the amount of γ rays is proportional to the amount of emanation present, provided measurements are made several hours after the introduction of the emanation into a vessel, in order to allow the excited activity to reach a maximum value. The rate of discharge due to the γ rays was somewhat diminished, but this was due to an increased absorption of the β rays by the solution, and not to a change in the rate of emission of these rays. On account of the great penetrating power of the γ rays, the increased absorption due to the presence of the solution was negligible.

Since, after solution, the radium bromide was diffused through a mass of solution at least 1000 times the bulk of the solid radium bromide, we may conclude that a distribution of the radiating matter over a thousand times its original volume has no appreciable influence on its radio-activity.

This experiment shows that, over the range investigated, the radio-activity of radium is not influenced by its own intense radiations. This result is in agreement with previous observations, for neither the radio-activity of any active product nor the rate of loss of activity has been found to be affected by its degree of concentration.

It is thus improbable that the energy given out by radium is due to an absorption of an unknown external radiation which is similar in character to the radiations which are emitted. Experiments are in progress to test whether still further dilution of the radium solution produces any alteration in its radio-activity. E. RUTHERFORD.

McGill University, Montreal, December 18, 1903.

Relative Motion and Conservation of Energy.

I HAVE received a letter from a correspondent which has led me to think that certain points connected with elementary dynamics are very obscurely put forward in text-books and in elementary class teaching generally. Of these the following may be taken as examples:—

(1) A river is flowing at three miles an hour. If two steamers are ascending the river, making headway at the rate of three miles an hour, one propelled by the action of paddle wheels or a screw, and the other pulling itself up by means of a chain laid along the bed of a river, the former will have to exert twice the horse-power of the latter, although the resistance overcome and the distance travelled in any given time are the same in both cases. Why is this?

(2) If a man is standing in an express train going at sixty miles an hour, he will have to perform exactly the same amount of work to throw a body of mass 1 lb. forwards with a relative velocity of sixty miles an hour as if he threw it backwards with the same relative velocity.

Yet in the former case the kinetic energy of the mass is increased from 121 to 484 foot pounds, while in the latter it is decreased from 121 foot pounds to zero. The actual work done by the man is in every case 121 foot pounds. This result has the appearance of being in contradiction with the principle of work.

I have known many Cambridge lecturers who, when they attempted to solve problems of a similar character, arrived at very different results. I am able to account for the apparent contradictions of the principle of conservation of energy, although I did not learn to do so from text-books. The majority of readers of NATURE are also, doubtless, competent to explain them in their own way and to their own satisfaction. But a student reared on the conventional text-book cannot fail to think (if he exercises his thinking powers at all on the subject) that the laws of dynamics must be at fault somewhere. G. H. BRYAN.

The Universities and Technical Education.

HAVING just read Prof. Perry's address on "Oxford and Science," I am tempted to give my own views on technical education for the Government service, and especially for the service of India, with which I have been connected since 1869. My qualifications for this discussion are chiefly that I was Director of the Imperial Forest School at Dehra Dun, in India, for five years, and Deputy Director of that school for four years, and during those nine years I always instructed the students personally in one of their branches of study. The excellence of the Dehra Dun Forest School has lately been recognised by the French Government, which has decided to send its Tonquin and Cochin China foresters there to complete their technical training, after having learned European forestry at Nancy.

My experience in India has been that men who have taken university honours degrees in science make the best scientific Government servants, but need special training at a technical college to complete their education for the public service, just as candidates selected for the Indian Medical Service, after receiving a thorough European medical training, complete their education at Netley. The Government of India fully recognises the advantages of a university training for its administrative and judicial service, commonly known as the Indian Civil Service, of which it is the most important branch, also for its Educational and Geological Departments, and the head of the Indian Meteorological Department always comes from a university. Why not also candidates for its Engineering and Forestry Departments? For these important departments, at present, boys are recruited chiefly from the public schools, where they may or may not have acquired the rudiments of scientific knowledge. Surely better candidates could be obtained if the age-limit were raised, and men trained in science and who have obtained an honours degree at a university were taught the technical part of their business at a well equipped Government college, such as the Royal Indian Engineering College, Coopers Hill.

At present there is too much overlapping of studies at technical colleges, and immature students are hurried through their preliminary scientific studies and have not the necessary time to devote to subjects which will form their future life-work. The London medical schools are instances of this. With the best clinical instruction available at the London hospitals, each of these institutions maintains with difficulty a more or less complete staff to teach botany, physiology, &c., which should be taught at a central university. There would be a great saving of expenditure at technical colleges, and much greater efficiency, were the scientific education which is a necessary preliminary to technical knowledge acquired under the distinguished guidance of university professors. By passing through a university, candidates for the higher posts in the Government service would experience the excellent social atmosphere of the university by mixing with men who are preparing for all the different professions and positions in life, and would have a much broader training than is possible at a purely technical college, where there is always the danger of narrow views, and of the overcrowding of subjects of instruction.

I hear that men who have taken a degree at Cambridge in the excellent mechanical school there are readily admitted without paying fees to complete their technical training in large engineering workshops, and surely a wider knowledge of engineering could be obtained at a Government college, such as Coopers Hill, than at any private engineering workshop, where the work done must be of too special a character for Government service. The University of Cambridge does not contemplate being able to turn out finished engineers, but only men preliminarily trained for engineering, neither does it contemplate educating practical foresters, but merely men who have obtained a diploma in the theory of agriculture and forestry. There is a demand in the colonies, as well as in India and Egypt, and by some foreign countries, for English-speaking professors of engineering and forestry, as well as for trained engineers and foresters, and at present the supply of such men is quite inadequate, and frequently these appointments are given to foreigners, simply because properly trained men from our country are not available.

Forestry can be admirably taught at Coopers Hill, with 14,000 acres of the Windsor Forest at our doors, and with examples of forests at Alice Holt Wood, in the Chiltern Hills, and elsewhere, easily accessible by train. The splendid forests of the north of France are within a day's journey, while, after a six months' practical training in the German forests, no forester in the world can be better equipped than are our students. Were our first year students university men instead of schoolboys, America and the colonies would be tempted to send us more students, and one of the finest technical colleges in the world might be easily established.

Coopers Hill, January 1. W. R. FISHER.

Prof. Johannsen on Heredity.

I SHOULD be glad if you would allow me space for some remarks on two recent reviews of Prof. Johannsen's "Erblichkeit in Populationen," in the last issues of *Biometrika* and of NATURE (December 17) respectively, the former signed by Prof. Pearson and Prof. Weldon.

I find it difficult to understand Prof. Johannsen's book in the sense in which the reviewers have, apparently, read it. In both notices it is stated that, if the author's views were correct, the correlation between mother and daughter plants should be perfect. As I take it, however, Prof. Johannsen's view does not imply, and is not consistent with, such a hypothesis; he believes, and adduces evidence to show, that within the pure line "Der Rückschlag ist vollkommen, ganz bis zum Typus der Linie," and explains the result on the hypothesis that the germ-plasm structure (or whatever we may term it) for the pure line is constant, the variations purely somatic. Neither the existence of zero correlation between parent and offspring nor the assumed somatic character of variations, within the pure line, is consistent with perfect correlation between parent and offspring for the race at large. This misunderstanding, in my view, is fundamental.

With reference to the concluding paragraph of the review in NATURE, it may be pointed out that Prof. Johannsen undertook the definite task, clearly stated, of elucidating the nature of intra-racial heredity by the study of heredity within the pure line, *i.e.* the offspring of one self-fertilised individual. He has shown that the intensity of heredity between the first two generations sprung from such a single individual may be vanishingly small, although it is quite sensible within the race at large. The result is of great importance both as regards the theory of heredity and the practice of breeding, and the work cannot be termed in any sense a failure.

One would, certainly, wish that Prof. Johannsen had employed more advanced statistical methods, and one may